

Assembly and Operation of the



BASIC AMATEUR BAND RECEIVER

MODEL HR-10B



HEATH COMPANY
BENTON HARBOR,
MICHIGAN 49022

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The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

SPECIFICATIONS

Frequency Coverage-

80 Meter Band.	3.5 to 4.0 mc.
40 Meter Band.	7.0 to 7.3 mc.
20 Meter Band.	14.0 to 14.35 mc.
15 Meter Band.	21.0 to 21.5 mc.
10 Meter Band.	28.0 to 29.7 mc.
Intermediate Frequency (IF).	1681.0 kc.
Sensitivity.	1 microvolt for a 10 db signal plus noise-to-noise ratio.
Selectivity	3 kc at 6 db down, 9 kc at 40 db down.
Image Rejection.	40 db or better.
Input Impedance.	50 to 75 Ω , coaxial.
Audio Output Impedance	8 Ω , or 500 Ω .
Panel Controls.	AF GAIN, AC OFF-ON. RF GAIN. BFO TUNE. BAND Switch. MAIN TUNING. CALibrate. ANTenna TRIMmer. REC-STBY Switch. CALibrate ON-OFF. BFO On-OFF. AVC On-OFF. ANL On-OFF.
Tube Complement.	6BZ6 RF Amplifier. 6EA8 Mixer Oscillator. 6BA6 1st IF Amplifier. 6EA8 2nd IF Amplifier-BFO. 6BJ7 Detector-AVC-ANL. 6GN8/6EB8 1st Audio-Audio output. 6X4 Rectifier.
Power Requirements.	105-125 or 210-250 volts AC, 50/60 cps, 50 watts.
Cabinet Size.	13-3/4" wide x 11-1/2" deep x 6-1/2" high.
Net Weight.	18 lbs.

INTRODUCTION

Your HEATHKIT Model HR-10B Basic Amateur Band Receiver is designed for use as a high-performance economical station receiver. Frequency coverage of the Receiver includes the amateur bands, 80 through 10 meters, only. Each band is separately calibrated on a large easy-to-read slide-rule dial. The dial is illuminated and provides approximately 6 inches of band-spread for each band.

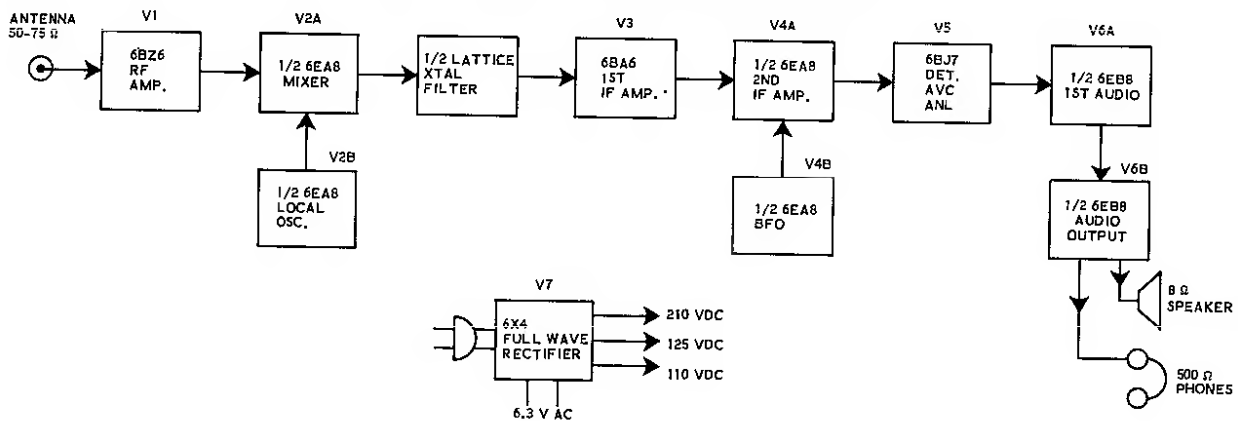
The Receiver features a signal strength "S" meter, a front panel dial calibration control that operates in conjunction with the 100 kc crystal calibrator provisions, a tuned RF ampli-

fier stage, a crystal filter, an automatic noise limiter circuit, plus many other features desirable on an Amateur Receiver. The low-silhouette styling and the green-gray color combination will prove an attractive addition to any surroundings.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

CIRCUIT DESCRIPTION

$$\times 10m / 20 = 15.681 \text{ Mc}$$



To assist you in understanding the following Circuit Description, we suggest that you refer frequently to the Schematic and Block Diagrams. As the BAND switch is quite complex, the circuit will be discussed with the switch in the 80 meter position.

RF AMPLIFIER - MIXER OSCILLATOR

Assuming that the BAND switch is in the 80 meter position, the signal from the antenna is applied through coil L1, through the BAND switch, and through capacitor C7 and resistor R1 to the grid of the RF amplifier tube, V1.

V1 amplifies the RF signal which is then applied through capacitor C18 and resistor R10 to the grid in the pentode section of tube V2. Tube V2 is a combination mixer and oscillator.

This tube heterodynes or mixes the incoming signal frequency with the oscillator frequency to obtain a difference frequency of 1681 kc. The position of the BAND switch determines which

coils and capacitors are used in conjunction with V2B in the oscillator circuit. These coils and capacitors, including the MAIN TUNING capacitor, are used to set the oscillator frequency 1681 kc higher than the desired radio station frequency. The difference frequency of 1681 kc is called the intermediate frequency or IF signal.

× When the Receiver is used on 10 and 15 meters, the oscillator operates at 1/2 the incoming frequency plus the intermediate frequency. The difference frequency, or IF, is obtained by beating the second harmonic of the oscillator frequency against the incoming signal. ×

IF AMPLIFIER

From the plate of V2A, the signal is coupled through IF transformer T1 to the grid of the first IF amplifier tube, V3.

A crystal filter is used in the secondary circuit of the IF transformer to provide a narrow bandpass for suppression of unwanted adjacent signals. This provides the Receiver

with exceptionally good selectivity.

Amplified IF signal from the plate of V3 is coupled through second IF transformer T2 to the grid of IF amplifier tube V4A. Tube V4A again amplifies the IF signal. At this point in the circuit the Beat Frequency Oscillator (BFO) signal from V4B may be beat with the IF signal by turning the BFO switch to BFO. The introduction of the BFO signal produces an audible signal for Continuous Wave (CW) or Single Sideband (SSB) reception. The output from V4A is coupled through IF transformer T3 to tube V5.

DETECTOR-AUDIO OUTPUT

Tube V5 is the detector stage. This tube detects the audio signal from the IF signal. This

audio signal is then coupled through capacitor C35 and the AF GAIN control to the grid of the first audio stage V6A. The amount of audio signal applied to the grid of V6A can be regulated by the AF GAIN control. This in turn regulates the amount of audio signal that will be amplified by V6A. From tube V6A, the audio signal is coupled by capacitor C38 to the grid of tube V6B. Tube V6B further amplifies this audio signal and feeds it through audio output transformer T4 to the Speaker jack.

POWER SUPPLY

The power supply uses tube V7 as a full-wave rectifier with power transformer T6. Filtering of the DC voltage is provided by resistors R44 and R43, and capacitors C55, C56, and C57.

CONSTRUCTION NOTES

This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. The arrangement shown is the result of extensive experimentation and trial. If followed carefully, the result will be highly stable and dependable performance. We suggest that you retain the manual in your files for future reference, both in the use of the equipment and for its maintenance.

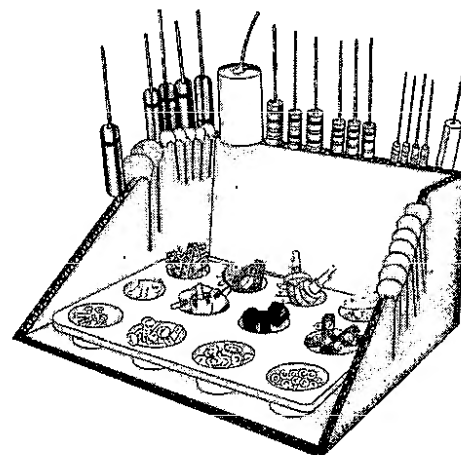
UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the information on the inside covers of the manual to help you identify the components. If some shortage or parts damage is found in checking the Parts List, please read the Replacements section and supply the information called for therein.

Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed with their lead ends inserted in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used.

Resistors generally have a tolerance rating of 10% unless otherwise stated in the Parts List. Tolerances on capacitors are generally even greater. Limits of +100% and -20% are common for electrolytic capacitors.

We suggest that you do the following before work is started:

1. Lay out all parts so that they are readily available.
2. Provide yourself with good quality tools. Basic tool requirements consist of a screwdriver with a 1/4" blade; a small screwdriver with a 1/8" blade; long-nose pliers; wire cutters, preferably separate diagonal cutters; a penknife or a tool for stripping insulation from wires; a soldering iron (or gun) and rosin core solder. A set of nut drivers and a nut starter, while not necessary, will aid extensively in construction of the kit.



ALIGNMENT

IF TRANSFORMER ALIGNMENT AND METER ZERO ADJUSTMENT

Equipment Required: An amplitude modulated RF signal generator and an AC voltmeter.

() Set all front panel controls as follows:

AF GAIN	12 o'clock
RF GAIN	Maximum clockwise
BFO TUNE	12 o'clock
BAND Switch	80 meters
MAIN TUNING	3.5 mc
ANL	OFF
AVC	OFF
BFO	OFF
CAL	OFF
STBY-REC	REC

- () Connect a jumper wire from lug 9 of tube socket V2 to lug 1 of terminal strip Q. This disables the oscillator for IF transformer alignment.
- () Connect one lead of the AC voltmeter to lug 1 of Speaker jack BA on the rear apron. Connect the other test lead to ground.
- () Make sure that the speaker is still connected to the Speaker jack.
- () Connect the positive or hot lead of the signal generator to the center lug of the ANTenna connector on the rear apron.
- () Turn all of the equipment on and let it warm up for approximately 30 minutes to stabilize all circuits.
- () Place the meter on the 3 or 5 volt range and set the generator for a high output level. The output of the generator should be reduced as the alignment procedure increases the sensitivity of the Receiver to keep the meter reading at approximately 1-1/2 volts.
- () Start alignment of the IF transformer by adjusting the signal generator for maximum indication on the meter. The generator reading at this time may be slightly above or below the 1682 kc IF frequency.

- () Adjust the bottom slug of the IF transformer T3 for maximum meter indication. Then adjust the top slug of T3 for a maximum indication. Proceed to transformer T2 and adjust the bottom slug for a maximum indication, then adjust the top slug.
- () Adjust the top slug of T1 for a maximum indication, and then adjust the bottom slug.
- () Adjust the signal generator frequency for a maximum meter indication. Then repeat the above IF transformer alignment steps.
- () Repeat the entire procedure described above, each time adjusting the signal generator until further adjustment does not cause an increase in meter reading.

Refer to Figure 2 for the locations of the transformers called for in the following steps.

- () Place the BFO switch in the ON position. Turn the modulation switch on the signal generator to off. Turn the slug in the BFO coil until you obtain a zero beat. Be sure that the BFO tuning knob is in the 12 o'clock position and that the signal generator is peaked for maximum voltage reading.
- () Rotate the BFO tuning knob each side of the 12 o'clock position. For the same amount of rotation in each direction, the tone should be the same frequency except at the extreme clockwise and counterclockwise positions, where there is nonlinearity of the variable capacitor. If the tone is not the same frequency, readjust the BFO coil.
- () Turn the BFO switch to OFF and turn the modulation of the generator on.
- () This completes the alignment of the IF stages in your Receiver. Disconnect the test equipment and remove the jumper wire from lug 9 of tube socket V2 to lug 1 of terminal strip Q.
- () Temporarily place a short from the center lug of the ANTenna connector to ground with a screwdriver.

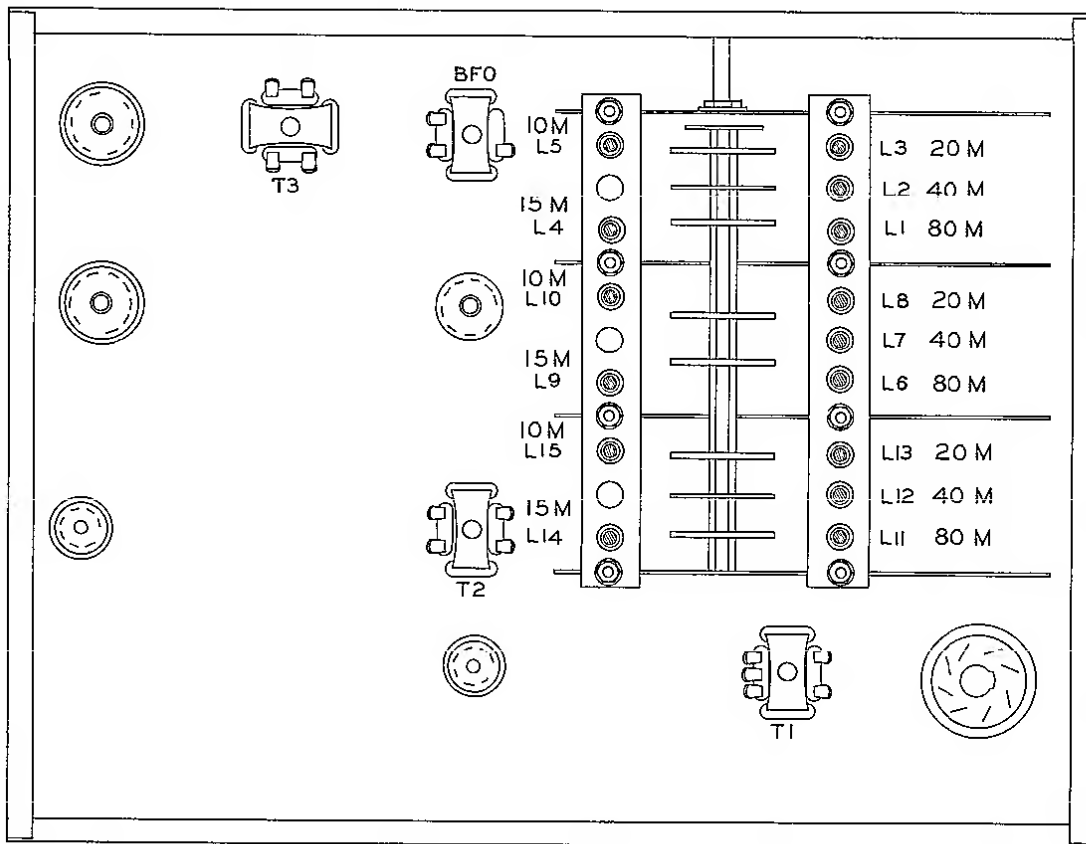


Figure 2

- () Temporarily short the antenna connector to ground. Be sure that the RF GAIN control is in its maximum clockwise position and the AVC switch is in the AVC position. Adjust the METER ZERO ADJ control for a zero reading on the "S" meter.
- () Remove the short from the antenna connector.

FRONT END ALIGNMENT

In order to obtain optimum results from the Receiver, the front end assembly should be aligned with an accurate amplitude modulated RF signal generator and an AC voltmeter.

It is very important that the signal generator be very accurate. Therefore, the generator should be calibrated against a crystal calibrator or receiver of known accuracy. If the HRA-10-1 Crystal Calibrator has been purchased, it should be assembled at this time and used to calibrate the signal source.

When performing the following steps, bear in mind that the front end assembly has been preset by the manufacturer, however, due to differences in tubes and assembly techniques, some realignment will be necessary. Usually this will consist of not more than 1/2 turn of the coil slugs.

() Set all front panel controls as follows:

AF GAIN	Maximum clockwise
RF GAIN	Maximum clockwise
BFO TUNE	12 o'clock
MAIN TUNING	As indicated in Alignment chart.
BAND Switch	As indicated in Alignment chart.
BFO	OFF
ANL	OFF
AVC	OFF
STBY-REC	REC
CAL RESET	12 o'clock
ANT TRIM	12 o'clock

() Connect the RF signal generator to the ANT-enna connector.

() Connect the AC voltmeter across the Speaker jack.

() Complete each step as indicated in the following chart. Refer to Figure 3 for the location of each coil. Be sure to keep the signal generator level as low as possible while still obtaining a usable reading of the meter, this should be just above the normal noise level.

FRONT END ALIGNMENT CHART			
BAND SWITCH POSITION	RECEIVER AND GEN. FREQ.	ADJUST FOR MAX	SECTION BEING ADJUSTED
80 meters	3.50 mc	L11 *	Oscillator
	3.75 mc **	L1 and L6	Antenna and mixer coils
40 meters	7.00 mc	L12 *	Oscillator
	7.15 mc **	L2 and L7	Antenna and mixer coils
20 meters	14.00 mc	L13 *	Oscillator
	14.15 mc **	L3 and L8	Antenna and mixer coils
15 meters	21.00 mc	L14 *	Oscillator
	21.25 mc **	L4 and L9	Antenna and mixer coils
10 meters	28.00 mc	L15 *	Oscillator
	29.00 mc **	L5 and L10	Antenna and mixer coils

*There will be no signal heard until these coils are peaked near the correct setting. Once the correct setting is found, carefully adjust for a maximum reading.

**Set the Receiver and generator frequency as indicated in the chart and adjust the CAL RESET until the signal is heard.

- () Rotate the MAIN tuning capacitor until a CW station is located.
- () Adjust the BFO TUNE control for the most comfortable listening tone.
- () It is usually best to adjust the listening level using the RF GAIN control. This provides maximum RF amplification for a weak signal.

SSB OPERATION

For SSB reception, set the controls as explained for CW operation, except turn the AVC

(OFF?)

switch to AVC and adjust the BFO TUNE control as follows: The BFO TUNE control will normally be set at 10 o'clock for upper SSB stations and 2 o'clock for lower SSB stations. Upper sideband transmission is usually used on the 10, 15, and 20 meter bands. Lower sideband transmission is usually found on 40 and 80 meters. Should you find it impossible to tune in a SSB station, reverse the BFO TUNE control setting, as this station may be transmitting on the other sideband.

As with CW reception the listening level should be adjusted with the RF GAIN control, with the AF GAIN control in the 3 o'clock position.

ANTENNA

The Receiver will operate using a long wire attached to the antenna connector, however, for the best results the antenna should have an impedance of 50 to 75 Ω . This could be a dipole type antenna. The dipole should be constructed for the band that you desire to receive. Naturally, if this Receiver is to be used in conjunction with a transmitter, the transmitting antenna should also be used for reception. For this

type of operation, a method for switching the antenna from the transmitter to the Receiver must be used.

If you wish to construct a dipole type of antenna, we suggest that you refer to the ARRL Handbook, an Antenna Handbook, or one of the periodical amateur radio magazines. These references are available at most Radio-TV Distributors.

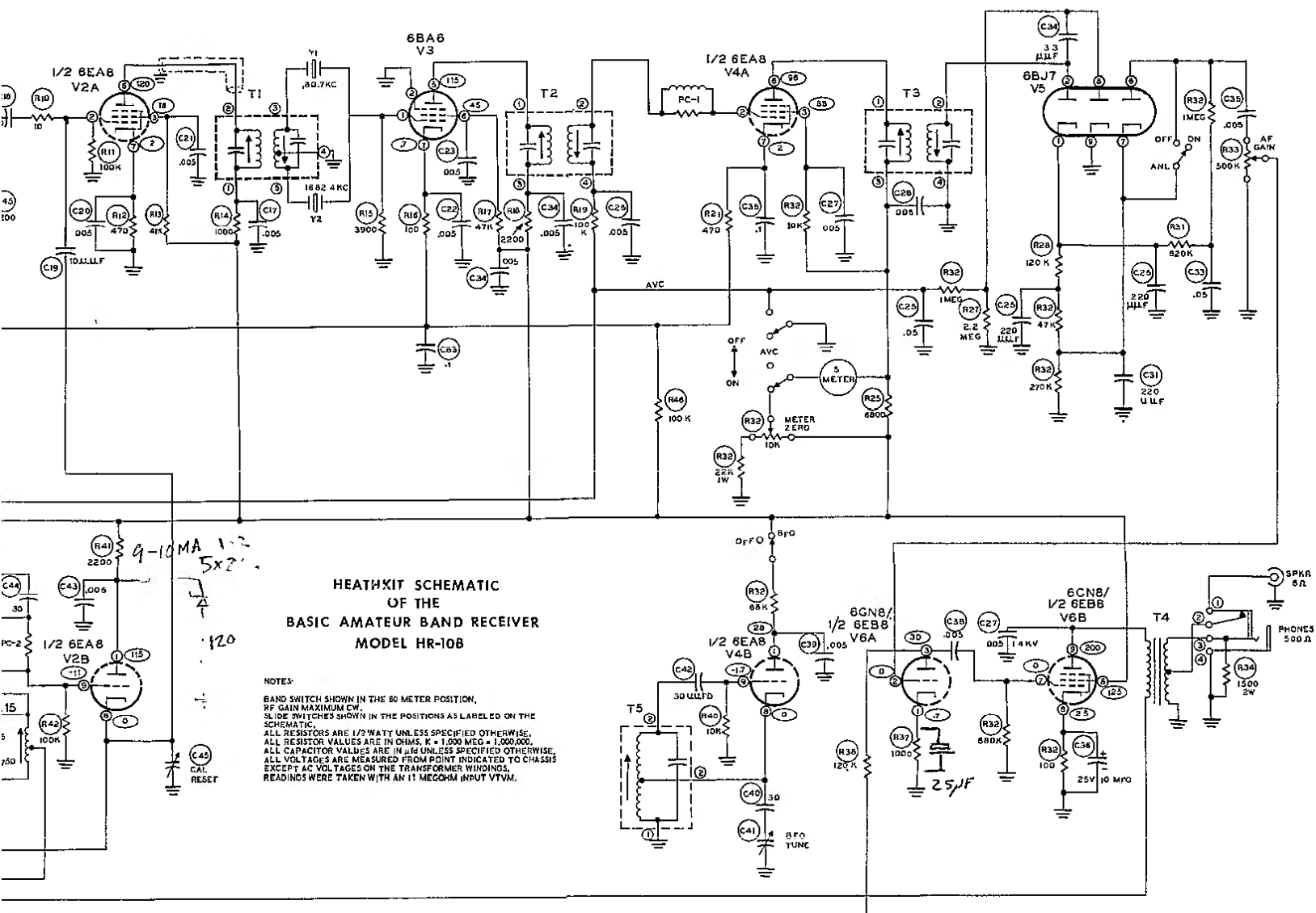
IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.
2. It is interesting to note that about 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Proper Soldering Techniques section of this manual.
3. Check to be sure that all tubes are in their proper locations. Make sure that all tubes light up properly.
4. Check the tubes with a tube tester or by substitution of tubes of the same types and known to be good.
5. Check the values of the parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.
6. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.
7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown on the Schematic Diagram. NOTE: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 10%.
8. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover of the Manual.

SPECIFIC PROBLEMS

PROBLEM	CHECK
Filaments do not light.	<ol style="list-style-type: none"> 1. Check fuse. 2. Check filament wiring. 3. Open tube filament - Check for continuity with an ohmmeter. 4. Check power transformer wiring against Pictorial 2.
Filaments light, but no sound with GAIN controls turned fully clockwise.	<ol style="list-style-type: none"> 1. Make sure the STBY-REC Switch is not in STBY position, check muting circuit. 2. Check wiring of the GAIN controls. <div style="border: 1px solid black; padding: 5px;"> <p>CAUTION: When making the following checks, do not touch the chassis with your other hand. Be sure that the chassis is not connected to an earth ground and that you touch only the specified lug on the tube socket.</p> </div> <ol style="list-style-type: none"> 3. Turn the Receiver on and place a small screwdriver on lug 7 of tube socket V6, then touch your finger to the metal portion of the screwdriver; a low pitched hum should be audible. 4. Now place the screwdriver on lug 2 of tube socket V6. Again touch your finger to the metal portion, this time the hum should be louder. If no hum is present check the components of tube V6 and the wiring to the speaker jack.
Audio present - no signals can be heard.	<p>CAUTION: When making the following tests, do not touch the chassis with your other hand.</p> <ol style="list-style-type: none"> 1. Place a small screwdriver on lug 2 of tube socket V4 and with your finger, touch the metal portion of the screwdriver. A low pitched hum should be heard. If no hum is present, check the components around tube socket V4. 2. Similarly, make the screwdriver test on lug 1 of tube socket V3. The hum should be louder. 3. Similarly, make the screwdriver test on lug 2 of tube socket V2. The hum should be louder. 4. Similarly, repeat the screwdriver test on lug 1 of tube socket V1. The hum should be louder. If no hum is present or if the hum level does not increase, check the components on the circuit around the tube sockets.



DGR
12V 4067
28MHz
PR 414P

